1 Tools and Services Provided by AMMOS

Downlink
Downlink provides for capturing and distributing Flight System data, maintaining knowledge of Flight System performance and ensuring its continued health and safety. It also provides system engineering to sustain these capabilities.
GDS Integration, Test, Deployment & Support
GDS Integration, Test, Deployment & Support provides for integrating, installing, and maintaining Ground Data System (GDS) hardware and software in operational and test environments.
Navigation & Mission Design
Navigation and Mission Design provides for maintaining knowledge of Flight System location/velocity and planning its trajectory for future mission activities.
Operations Engineering
Operations Engineering provides cross-cutting and support functions necessary to operate and sustain a Mission Operations System.
Planning & Sequencing
Planning & Sequencing provides for planning and commanding the science observations and engineering activities of a Mission and the engineering needed to sustain that capability.

1.1 Downlink

Downlink provides for capturing and distributing Flight System data, maintaining knowledge of Flight System performance and ensuring its continued health and safety. It also provides system engineering to sustain these capabilities.
Data Archive
Provides life-of-mission archiving of all telemetry (science and engineering), and tools and services for accessing archived data.
Instrument Data Processing
Provides science data processing at Level 1 and above, automated notification of data product availability and rapid-turnaround of products required for planning.
Spacecraft Health & Performance Monitoring
Provides tools for analysis of spacecraft subsystem telemetry (e.g., Power, Thermal). Provides processes for monitoring, performance trending, and analysis of spacecraft health and performance data. Provides spacecraft feedback and inputs to mission planning.
Telemetry Processing and Display
Accepts DSN-standard formats from DSN Telemetry Services, including frames, packets, and/or files. Provides Level 0-1 processing of telemetry (DN to EU), channelization, display and query capabilities, and short-term storage of telemetry.

1.1.1 Data Archive

Provides life-of-mission archiving of all telemetry (science and engineering), and tools and services for accessing archived data.

Data Archive Services

Multimission Data Management Team
DMT provides a multimission service that supports long-term data archive and associated engineering support for the mission operations environment.

Data Archive Tools

Archive and Catalog of Mission Engineering Data
Provides for mission engineering data archive and catalog. DOM provides the capability for a catalog of mission files (primarily uplink), based on project-unique schema. AMPCS provides the capability for a catalog of mission data (Packets and Channels). Multimission Data Management Team (DMT) provides engineering support in this area.

1.1.1.1 Multimission Data Management Team

DMT provides a multimission service that supports long-term data archive and associated engineering support for the mission operations environment.

1.1.1.2 Archive and Catalog of Mission Engineering Data

Provides for mission engineering data archive and catalog. DOM provides the capability for a catalog of mission files (primarily uplink), based on project-unique schema. AMPCS provides the capability for a catalog of mission data (Packets and Channels). Multimission Data Management Team (DMT) provides engineering support in this area.

1.1.2 Instrument Data Processing

Instrument Data Processing provides tools and services for science instrument data product generation, which includes processing: display and delivery of science and related engineering data for use by instrument engineers, activity and science planners, in-situ drivers and operators; and public information releases.

Instrument Data Processing Services

3D Animation/Visualization Service
Integrated data visualization and 3D-HDTV-rendering services that incorporate navigation and ephemeris files, CAD models, and remotely sensed images to support visualization for strategic operations (1-day to 2-week turnaround time).
Experiment Product Generation Service
Provides adapted (Instrument Operations Systems) IOS tools and operations team to perform processing of instrument data (telemetry stream, SFDUs or CFDP files), and creates archive-ready Level-0 data products. Validates and catalogs Level-0 products (Experiment Data Records).
Image/Experiment Data Record Display Service
Image/Experiment Data Record Display Tools provide for display of image files in a variety of image formats: JEDI (Java EDR (Experimental Data Record) Display Interface) is a JAVA-based near real-time image display capability. xvd is an X-windows, motif based Image Viewer that displays large images. JADE provides a high performance image viewer with rapid display of large images (gigabytes), including overlays, stereo display (anaglyph, color glyph, and Java 3D), pan, and zoom features. [Note: IOS does not provide tool adaptation unless the project requests and funds the tool adaptation.]
Instrument Product Access/Delivery Service
Provides delivery of instrument products to remote sites. Tracks, delivers, and provides accountability information about delivered products and provides access to Level-0 products (EDRs) and Level-1 or higher products (RDRs)
Science Data Infrastructure Service
Science Data Infrastructure Service provides the following services: a) Monitors system processes and performance. b) Provides a long-term repository for system/project programs and files. c) Provides hosting capability for project applications servers. d) Provides data facility support, including system administration, monitoring of system processes and performance and notification. e) Performs system maintenance activities, such as routine backups, user accounts, installation of Third Party Software. f) Performs analysis of requirements and provides design of hardware system to meet user requirements. g) Provide hardcopy services, such as custom image processing hardcopy (e.g., color corrected mosaics or combinations of multi-instrument data sets to provide photo-quality prints, including large scale format) and hardcopy visualizations or models (e.g., stereo lithography).
Tactical Product Generation Service
Provides automated production and delivery of tactical instrument data products (e.g., primarily for lander or rover projects, but can be used for orbiters) to end-users. As a service, it provides tactical instrument data products to the rover/lander planning team within a specified time constraint. It also provides automated delivery of the data products produced within a specific period of time. This includes tool adaptation and a trained project operations team that generates the specialized, higher-order [Level 1] or above) data products (Reduced Data Records [RDRs]), as well as the storage (and backup of) of data products for life of mission.

Instrument Data Processing Tools

APPS (AMMOS-PDS Pipeline Service)
APPS is a software suite that enables creation and validation of PDS4 labels and archive bundles by science data producers. It includes a distributed processing system that can attach to the operational data pipeline and produce archive ready products on the fly. Label Design Tool (LDT) - The LDT is a standalone APPS component that enables creation of PDS4 product labels.

Automated Task Invocation Tool
Automated, multimission instrument task invocation tool (MATIS), adapted for the customer, creates project-specific classes that facilitate automation of instrument data product generation or any systematic sequential processing (e.g., pipeline processing, workflow manager)
Image Format Translation Tool
Tool to translate from one image data format to another, while preserving meta-data content.
Image Processing Toolkit
The Image Processing Toolkit provides an integrated image processing program set, libraries, and a standardized interface. This tool set includes programs for image registration, image display, data conversion routines, pixel plots or listings, label processing and/or display, contrast enhancement, text and graphic overlays, color reconstruction, digital filters, fast Fourier transforms, image blemish removal, image orientation, geometric transformations, map projections, and radiometric calibration.
Image/Experiment Data Record Display Toolkit
The Image/Experiment Data Record Display Toolkit provides for display of image files in a variety of image formats:
Instrument Product Access/Delivery Tool
Automated, secure data delivery and integrity validation by subscription (e.g. type, mission, time, filename) within seconds of generation.
Tactical Product Generation Toolkit
Enables production of tactical instrument data products (e.g., primarily for lander or rover projects, but can be used for orbiters).

1.1.2.1 3D Animation/Visualization Service

Integrated data visualization and 3D-HDTV-rendering services that incorporate navigation and ephemeris files, CAD models, and remotely sensed images to support visualization for strategic operations (1-day to 2-week turnaround time).

1.1.2.2 Experiment Product Generation Service

Provides adapted (Instrument Operations Systems) IOS tools and operations team to perform processing of instrument data (telemetry stream, SFDUs or CFDP files), and creates archive-ready Level-0 data products. Validates and catalogs Level-0 products (Experiment Data Records).

1.1.2.3 Image/Experiment Data Record Display Service

Image/Experiment Data Record Display Tools provide for display of image files in a variety of image formats: JEDI (Java EDR (Experimental Data Record) Display Interface) is a JAVA-based near real-time image display capability. xvd is an X-windows, motif based Image Viewer that displays large images. JADE provides a high performance image viewer with rapid display of large images (gigabytes), including overlays, stereo display (anaglyph, color glyph, and Java 3D), pan, and zoom features.

[Note: IOS does not provide tool adaptation unless the project requests and funds the tool adaptation.]

1.1.2.4 Instrument Product Access/Delivery Service

Provides delivery of instrument products to remote sites. Tracks, delivers, and provides accountability information about delivered products and provides access to Level-0 products (EDRs) and Level-1 or higher products (RDRs)

1.1.2.5 Science Data Infrastructure Service

Science Data Infrastructure Service provides the following services: a) Monitors system processes and performance. b) Provides a long-term repository for system/project programs and files. c) Provides hosting capability for project applications servers. d) Provides data facility support, including system administration, monitoring of system processes and performance and notification. e) Performs system maintenance activities, such as routine backups, user accounts, installation of Third Party Software. f) Performs analysis of requirements and provides design of hardware system to meet user requirements. g) Provide hardcopy services, such as custom image processing hardcopy (e.g., color corrected mosaics or combinations of multi-instrument data sets to provide photo-quality prints, including large scale format) and hardcopy visualizations or models (e.g., stereo lithography).

1.1.2.6 Tactical Product Generation Service

Provides automated production and delivery of tactical instrument data products (e.g., primarily for lander or rover projects, but can be used for orbiters) to end-users. As a service, it provides tactical instrument data products to the rover/lander planning team within a specified time constraint. It also provides automated delivery of the data products produced within a specific period of time. This includes tool adaptation and a trained project operations team that generates the specialized, higher-order [Level 1] or above) data products (Reduced Data Records [RDRs]), as well as the storage (and backup of) of data products for life of mission.

1.1.2.7 APPS (AMMOS-PDS Pipeline Service)

APPS is a software suite that enables creation and validation of PDS4 labels and archive bundles by science data producers. It includes a distributed processing system that can attach to the operational data pipeline and produce archive ready products on the fly.
Label Design Tool (LDT) - The LDT is a standalone APPS component that enables creation of PDS4 product labels.

1.1.2.8 Automated Task Invocation Tool

Automated, multimission instrument task invocation tool (MATIS), adapted for the customer, creates project-specific classes that facilitate automation of instrument data product generation or any systematic sequential processing (e.g., pipeline processing, workflow manager)

1.1.2.9 Image Format Translation Tool

Tool to translate from one image data format to another, while preserving meta-data content.

1.1.2.10 Image Processing Toolkit

The Image Processing Toolkit provides an integrated image processing program set, libraries, and a standardized interface. This tool set includes programs for image registration, image display, data conversion routines, pixel plots or listings, label processing and/or display, contrast enhancement, text and graphic overlays, color reconstruction, digital filters, fast Fourier transforms, image blemish removal, image orientation, geometric transformations, map projections, and radiometric calibration.

1.1.2.11 Image/Experiment Data Record Display Toolkit

The Image/Experiment Data Record Display Toolkit provides for display of image files in a variety of image formats:
· JEDI (Java EDR (Experimental Data Record) Display Interface): Provides a JAVA-based near real-time image display capability.
· Xvd: Provides an X-windows, motif based Image Viewer that displays large images.
· JADE: Provides a high performance image viewer with rapid display of large images (gigabytes), including overlays, stereo display(anaglyph, color glyph, and Java 3D), pan, and zoom features.
· Marsviewer: Provides a rich-client display tool for browsing and viewing image data products and visualizing their content
· Webification: Provides a ReSTful web service (w10n) framework that facilitates direct, browser-based access to instrument data products and applications from any location.

1.1.2.12 Instrument Product Access/Delivery

Tool

Automated, secure data delivery and integrity validation by subscription (e.g. type, mission, time, filename) within seconds of generation.

1.1.2.13 Tactical Product Generation Toolkit

Enables production of tactical instrument data products (e.g., primarily for lander or rover projects, but can be used for orbiters).

Integrates the derivation of the two components of the terrain model into a single, iterative process. The correlate currently creates some orientation information, which is ignored. This will be captured and used to create better orientations. In turn, these will be fed back to the correlate, where they will be used to predict what the opposite eye image should look like, creating a more precise match.

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1.1.3 Spacecraft Health & Performance Monitoring

Provides tools for analysis of spacecraft subsystem telemetry (e.g., Power, Thermal). Provides processes for monitoring, performance trending, and analysis of spacecraft health and performance data. Provides spacecraft feedback and inputs to mission planning.

Spacecraft Health & Performance Monitoring Tools

Telecom Prediction and Trending Analysis
Telecom Analysis provides a suite of tools to support telecom prediction and analysis. The TFP toolkit includes support for various environments and deployments, as well as a Web-based service.
Time Correlation
Time Correlation provides software for performing SCLK to SCET correlation and engineering support to predict spacecraft clock drift.

1.1.3.1 Telecom Prediction and Trending Analysis

Telecom Analysis provides a suite of tools to support telecom prediction and analysis. The TFP toolkit includes support for various environments and deployments, as well as a Web-based service.

1.1.3.2 Time Correlation

Time Correlation provides software for performing SCLK to SCET correlation and engineering support to predict spacecraft clock drift.

1.1.4 Telemetry Processing and Display

Accepts DSN-standard formats from
a) Telemetry All Frame Service or Virtual Channel Service,
b) Telemetry Packet Service, and
c) Telemetry File Service via CCSDS File Delivery Protocol (CFDP)

Performs the following processing:
a) Channel values are converted into engineering units (EU) from data numbers (DN).
b) Display spacecraft engineering channels
c) Query telemetry data (frames, packets, and files)
d) Provide short-term storage of these products

Telemetry Processing and Display Tools

AMPCS (AMMOS Mission Data Processing and Control System)
AMPCS provides a collection of telemetry and command software used during all phases of a mission (A through E). MPCS provides: Telemetry and Test Tools for ATLO Support, Mission Control Query Plotting Scripts, Flight System Telemetry Display and Alarm Generation, as well as the S/C Telemetry Monitor Toolkit.
RAMPAGE (Remote Access Multi-Mission Processing and Analysis Ground Environment)
RAMPAGE (Remote Access Multi-Mission Processing and Analysis Ground Environment) provides data access to mission engineering data from a standard web browser. RAMPAGE is distributed as a server-side application that has been adapted to meet the needs of remote users.

1.1.4.1 AMPCS (AMMOS Mission Data Processing and Control System)

Telemetry Input Handling

- Processing of CCSDS-formatted spacecraft telemetry in packet format.
- Handling of DSN-generated SFDU wrappers
- Reading of telemetry from a file, socket, DSN Emulator, DSN Telemetry Data System (TDS), or previouslycreated AMPCS database.
- Real-time notification and logging of status of connection to telemetry source Telemetry Packet Handling
- Storage of packet data and metadata to database
- Periodic real-time notification and logging of packet processing status
- Packet gap analysis tool
- Scrolling GUI and command line views of received packet statistics Channel Processing
- Extraction of telemetry channel samples from real-time and recorded pre-channelized packets
- Extraction of telemetry channel samples from packets using a decommutation map
- Channelization of packet header/wrapper metadata
- Channelization of DSN MON-0158 data
- Derivation of new channel samples from existing ones using bit unpack or custom algorithms
- Engineering Unit calculation using table, polynomial, or custom algorithm
- Publication of channel samples on the real-time message service and archival of channel samples in the database
- Tabular, Plot, and Custom Layout GUI views of channelized data
- Scrolling command-line views of incoming channel samples
- Telemetry channels and metadata storage (databases).

Alarm Processing

- Channel alarm computation for both real-time and recorded telemetry channels
- Centralized calculation of high value, low value, inclusive range, exclusive range, mask, state, change, delta, digital, and combination alarm types.
- Support for both project and user level alarm definition files
- Publication of alarms on the real-time message service and archival of alarm events with channel samples in the database

- Alarm GUI view

Session Handling

- Unique identification of each AMPCS session and all related data
- Storage of all session configuration to the database
- Single session output directory for all files in test venues
- Migration of data between databases by session

Reporting

- Query for all basic types of data in the AMPCS database: sessions, packets, channel samples, log messages.
- Selection from several standard report formats (CSV, summary, XML, etc) or user-defined format
- Integrated session reports and data summary reports
- Interactive plotting of channelized telemetry from the database

Automation Support

- MTAK (MPCS Test Automation Toolkit) python library
- Automatic alarm notification via text or e-mail
- Script triggering based upon real-time message service notifications
- Concurrent migration of data from local to remote database
- Fixed View perspective python library for writing scripts that generate displays

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1.1.4.2 RAMPAGE (Remote Access Multi-Mission Processing and Analysis Ground Environment)

RAMPAGE (Remote Access Multi-Mission Processing and Analysis Ground Environment) provides data access to mission engineering data from a standard web browser. RAMPAGE is distributed as a server-side application that has been adapted to meet the needs of remote users.

1.2 GDS Integration, Test, Deployment & Support

The GDS Integration, Test, Deployment & Support functions offer Flight Projects the option of utilizing experts in AMMOS integration, installation, testing, monitoring and maintaining the Uplink and Downlink functions of AMMOS resulting in a highly operable GDS component. AMMOS GDS Integration engineers work as embedded members of the Project GDS team working fully with the Project ground data system engineer(s) and Project integration, test and deployment engineer(s). GDS deployments into Project Testbed, Assembly Test Launch Operations (ATLO) and Flight Operations environments is provided.

GDS Integration has experience deploying and maintaining GDSs for most major Project operations scenarios including Orbiter (with relay), Lander, Fly By with Earth Return and Earth Trailing Observatories.

GDS Integration, Test, Deployment & Support
Provides a standard, cost effective, AMMOS configuration which allows AMMOS GDS deployments across one or more Projects enabling them to share common deployment and operations

1.2.1 GDS Integration, Test, Deployment & Support

Provides a standard, cost effective, AMMOS configuration which allows AMMOS GDS deployments across one or more Projects enabling them to share common deployment and operations procedures with minimal tailoring to specific Project needs. Provides the use of standard operations tools which have been developed over years of supporting Projects allowing maximum automation and coordination of GDS functions and roles. Use of a standard AMMOS configuration saves Project money due to use of a proven deployment configuration and utilization of existing operations support tools and services.

Provides integration, verification and validation of multimission or single-project instantiations of AMMOS GDS. Deploys AMMOS GDS (including third-party software) to workstations. Provides server administration services, hardware and software maintenance. Includes GDS support to Testbed environments as well as GDS-only test environments. Enables missions to share common deployment and operations procedures with minimal tailoring to specific Project needs.

GDS Integration, Test, Deployment & Support Services

Integrated GDS with DSNE (Deep Space Network Emulator)
Integrated and tested GDS delivery with DSNE. DSN will maintain and deliver the DSNE to MGSS. MGSS is responsible for integrating and testing the DSNE with the rest of the MGSS provided GDS and delivery to the project.

Integrated Linux GDS process and procedures
Provides proven multimission processes and procedures, including GDS planning, coordination, delivery reviews, Integration & Test, Test Readiness Reviews and Mission Change Requests (MCR) generation. Provides fully functional, integrated and tested AMMOS Ground Data System software.

Multimission GDS Testbed Facility
The facilities are available for a multimission test-bed. Included are: clean power, availability of ports, chairs, location. Not included is the hardware or virtual machines that would be used and paid for by the project as well as the network port connections.

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Provides proven multimission processes and procedures, including GDS planning, coordination, delivery reviews, Integration & Test, Test Readiness Reviews and Mission Change Requests (MCR) generation. Provides fully functional, integrated and tested AMMOS Ground Data System software.

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The facilities are available for a multimission test-bed. Included are: clean power, availability of ports, chairs, location. Not included is the hardware or virtual machines that would be used and paid for by the project as well as the network port connections.

1.3 Navigation & Mission Design

Navigation and Mission Design provides for maintaining knowledge of Flight System location/velocity and planning its trajectory for future mission activities.

Mission Design
Provides analysis and design of spacecraft trajectory for mission planning purposes. Includes generation of trajectory predictions in support of all possible launch dates and times, analysis of tracking requirements, planetary protection analysis, and strategies for orbit determination.

Navigation
Provides navigation services for spacecraft operations. Includes trajectory prediction and analysis, maneuver design and reconstruction, and orbit determination.

Solar System Dynamics
Provides natural body ephemerides and associated uncertainties for solar system objects (planets, natural satellites, and many asteroids and comets). Provides spherical harmonic gravity models for Moon, Venus, Mars, and other bodies.

SPICE
Provides tools and services focused on solar system geometry, time, and related information for use in observation planning, interpretation of instrument data, and various engineering tasks related to space geometric information for spacecraft and instruments.

1.3.1 Mission Design

Provides analysis and design of spacecraft trajectory for mission planning purposes. Includes generation of trajectory predictions in support of all possible launch dates and times, analysis of tracking requirements, planetary protection analysis, and strategies for orbit determination.

Mission Design Services

Entry, Descent, and Landing Analysis and Design
Analysis and design of atmospheric entry, descent and landing (EDL). Analysis and optimization of entry parameters and descent profiles. Evaluation of landing accuracy, landing hazards, and success probability. Monte Carlo analysis of EDL trajectories. Also applies to analysis of scenarios where there is no atmosphere (i.e., descent and landing).

Launch Trajectory and Vehicle Performance Analysis
Optimization of launch vehicle targets to increase the range of launch opportunities or to improve margins.

Mission Design and Trajectory Optimization
Refinement and optimization of trajectories that fulfill the mission requirements, including any combination of maneuvers, gravity assists, low-thrust segments, aero-assist segments, and low energy transfers. Refinement of launch and arrival date ranges. Detailed design of operational orbits. Analysis of delta-V budgets. Analysis and re-optimization of trajectories after a mission event that requires a replanning of the mission.

Preliminary Mission Design
Discovery of trajectories that fulfill the mission needs, including any combination of maneuvers, gravity assists, low-thrust segments, aero-assist segments, and low-energy transfers in support of pre-Phase-A and Phase-A studies. Determination of launch and arrival date ranges. Preliminary design of operational orbits.

Vehicle Break-up Analysis
Analysis of vehicle break-up scenarios on nominal and contingency launches, entries, or re-entries. Assessment of probabilities and risk of ground impact for spacecraft components.

1.3.1.1 Entry, Descent, and Landing Analysis and Design

Analysis and design of atmospheric entry, descent and landing (EDL). Analysis and optimization of entry parameters and descent profiles. Evaluation of landing accuracy, landing hazards, and success probability. Monte Carlo analysis of EDL trajectories. Also applies to analysis of scenarios where there is no atmosphere (i.e., descent and landing).

1.3.1.2 Launch Trajectory and Vehicle Performance Analysis

Optimization of launch vehicle targets to increase the range of launch opportunities or to improve margins.

1.3.1.3 Mission Design and Trajectory Optimization

Refinement and optimization of trajectories that fulfill the mission requirements, including any combination of maneuvers, gravity assists, low-thrust segments, aero-assist segments, and low energy transfers. Refinement of launch and arrival date ranges. Detailed design of operational orbits. Analysis of delta-V budgets. Analysis and re-optimization of trajectories after a mission event that requires a replanning of the mission.

1.3.1.4 Preliminary Mission Design

Discovery of trajectories that fulfill the mission needs, including any combination of maneuvers, gravity assists, low-thrust segments, aero-assist segments, and low-energy transfers in support of pre-Phase-A and Phase-A studies. Determination of launch and arrival date ranges. Preliminary design of operational orbits.

1.3.1.5 Vehicle Break-up Analysis

Analysis of vehicle break-up scenarios on nominal and contingency launches, entries, or re-entries. Assessment of probabilities and risk of ground impact for spacecraft components.

1.3.2 Navigation

Provides navigation services for spacecraft operations. Includes trajectory prediction and analysis, maneuver design and reconstruction, and orbit determination.

Navigation Services

Launch, Acquisition and Early Mission Orbit Determination
Generation of trajectory predicts in support of all possible launch dates and times, launch accuracy assessment, orbit determination and prediction in support of second station acquisition.

Navigation Analysis and Design
Analysis and design of the navigation plan, including optimization of tracking data types and tracking schedules, orbit determination strategy, prediction, delivery and reconstruction accuracy analysis and planetary protection analysis.

Optical Navigation
Analysis of optical navigation requirements and camera design. Determination of image parameters, pointing, and imaging schedules. Conversion of images into navigation observables. Determination of small-body surface models and dynamic characteristics based on optical images. May include utilization of the positions of landmarks on a body surface in the navigation process (i.e., landmark tracking).

Orbit Determination
Generation of accurate predicted and reconstructed trajectories using a combination of tracking data types. Generation of simulated trajectories and measurements for Operational Readiness Tests and other analysis.

Real-time Event Monitoring
Real-time monitoring of tracking data residuals during mission critical events (e.g. maneuvers, orbit insertions, proximity operations).

Trajectory Analysis and Maneuver Design
Analysis and re-optimization of trajectories and maneuvers that fulfill applicable mission requirements for different mission scenarios.

1.3.2.1 Launch, Acquisition and Early Mission Orbit Determination

Generation of trajectory predicts in support of all possible launch dates and times, launch accuracy assessment, orbit determination and prediction in support of second station acquisition.

1.3.2.2 Navigation Analysis and Design

Analysis and design of the navigation plan, including optimization of tracking data types and tracking schedules, orbit determination strategy, prediction, delivery and reconstruction accuracy analysis and planetary protection analysis.

1.3.2.3 Optical Navigation

Analysis of optical navigation requirements and camera design. Determination of image parameters, pointing, and imaging schedules. Conversion of images into navigation observables. Determination of small-body surface models and dynamic characteristics based on optical images. May include utilization of the positions of landmarks on a body surface in the navigation process (i.e., landmark tracking).

1.3.2.4 Orbit Determination

Generation of accurate predicted and reconstructed trajectories using a combination of tracking data types. Generation of simulated trajectories and measurements for Operational Readiness Tests and other analysis.

1.3.2.5 Real-time Event Monitoring

Real-time monitoring of tracking data residuals during mission critical events (e.g. maneuvers, orbit insertions, proximity operations).

1.3.2.6 Trajectory Analysis and Maneuver Design

Analysis and re-optimization of trajectories and maneuvers that fulfill applicable mission requirements for different mission scenarios.

1.3.3 Solar System Dynamics

Provides natural body ephemerides and associated uncertainties for solar system objects (planets, natural satellites, and many asteroids and comets). Provides spherical harmonic gravity models for Moon, Venus, Mars, and other bodies.

Solar System Dynamics Services

Gravity Modeling
Generation and provision of multimission gravity models for solar system bodies.
Natural Body Ephemeris
Generation of up-to-date natural body ephemeris and their associated uncertainties, either generic solar system ephemerides or specific ephemeris improvements required by a particular mission.

1.3.3.1 Gravity Modeling

Generation and provision of multimission gravity models for solar system bodies.

1.3.3.2 Natural Body Ephemeris

Generation of up-to-date natural body ephemeris and their associated uncertainties, either generic solar system ephemerides or specific ephemeris improvements required by a particular mission.

1.3.4 SPICE

Provides tools and services focused on solar system geometry, time, and related information for use in observation planning, interpretation of instrument data, and various engineering tasks related to space geometric information for spacecraft and instruments.

SPICE Services

NAIF (Navigation and Ancillary Information Facility) Data Processing
Production of SPICE files, either generic data or mission specific data. Provision of reduced and interpreted ancillary datasets to space scientists pertaining to their experiments. (See http://naif.jpl.nasa.gov/naif/index.html.)
SPICE Data/Kernels
Provision of generic reference data sets containing ancillary navigation data that may be accessed or manipulated via the SPICE Toolkit. Three separate sets of ephemerides are provided: planetary bodies, natural satellites, and small bodies (e.g., comets and asteroids). Data sets containing planetary constants and leap seconds are similarly provided.
SPICE Toolkit
The SPICE Toolkit (Spacecraft, Planet, Instrument, C-Matrix, Events) provides application programs and a subroutine library that read and write SPICE kernel files and calculate observation geometry quantities.

1.3.4.1 NAIF (Navigation and Ancillary Information Facility) Data Processing

Production of SPICE files, either generic data or mission specific data. Provision of reduced and interpreted ancillary datasets to space scientists pertaining to their experiments. (See http://naif.jpl.nasa.gov/naif/index.html.)

1.3.4.2 SPICE Data/Kernels

Provision of generic reference data sets containing ancillary navigation data that may be accessed or manipulated via the SPICE Toolkit. Three separate sets of ephemerides are provided: planetary bodies, natural satellites, and small bodies (e.g., comets and asteroids). Data sets containing planetary constants and leap seconds are similarly provided.

1.3.4.3 SPICE Toolkit

The SPICE Toolkit (Spacecraft, Planet, Instrument, C-Matrix, Events) provides application programs and a subroutine library that read and write SPICE kernel files and calculate observation geometry quantities.

1.4 Operations Engineering

Operations Engineering provides cross-cutting and support functions necessary to operate and sustain a Mission Operations System.
Configuration Management
The Configuration Management (CM) service provides projects with a CM program that is a cost effective discipline that utilizes a best practices approach to identify, control, deploy, audit and record changes to software, systems and components for Programs, Projects and Missions, to ensure accurate reproducibility. Configuration Management is a project's gateway for effective change control and ensures that controlled configuration components are uniquely identified, and all approved changes to controlled configurations are documented, tracked and if specified, deployed. The online CM tools are available to all project users to document problems, change requests, and provide defect tracking for the AMMOS tools.
GDS Engineering Support
Provides system engineering services and support needed to maintain ground data system functionality during operations. Includes software tools and scripts in support of process automation and improvement. Provides System Administration services, hardware and software maintenance. Provides single point-of-contact for GDS operations troubleshooting for time-critical environments or events.
Mission Support Facilities
Provides logistical consulting, architecture, engineering and support between communicating entities.
Operations Mission Assurance
Increases the likelihood of mission success by proactively contributing to the identification, assessment and mitigation of risks from formulation through implementation phases of a

project's life cycle.
Operations System Engineering
System engineering for the MGSS operations areas, and responsible for implementing the multimission operational team support for missions.

1.4.1 Configuration Management

The Configuration Management (CM) service provides projects with a CM program that is a cost effective discipline that utilizes a best practices approach to identify, control, deploy, audit and record changes to software, systems and components for Programs, Projects and Missions, to ensure accurate reproducibility.

Configuration Management is a project's gateway for effective change control and ensures that controlled configuration components are uniquely identified, and all approved changes to controlled configurations are documented, tracked and if specified, deployed.

The online CM tools are available to all project users to document problems, change requests, and provide defect tracking for the AMMOS tools.

Configuration Management Services

Configuration Management
The configuration management (CM) service provides change control management for flight and ground software. The CM service provides trained CM engineers and includes source code management, software build engineering, software environment configuration, change control, and release engineering. The CM Services provide an archive repository for mission released software, that is maintained locally as well as providing scheduled off-site backups. The CM service has been developed around industry standards and frameworks allowing for traceability, repeatability and accountability throughout a project's entire lifecycle. The CM service includes the web based OIA tools.

1.4.1.1 Configuration Management

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1.4.2 GDS Engineering Support

Provides system engineering services and support needed to maintain ground data system functionality during operations. Includes software tools and scripts in support of process automation and improvement. Provides System Administration services, hardware and software maintenance. Provides single point-of-contact for GDS operations troubleshooting for time-critical environments or events.

GDS Engineering Support Services

AMMOS GDS Site Rep
AMMOS GDS Site Representative works closely with Project GDSE, attends Project GDS Design Team meetings, Anomaly investigations. Provides and coordinates the AMMOS response to the project.
MGSS Web Services (MWS)
Provides a web hosting service for internal (not publically available) websites to support activities with the local and remote science team members, mission operations reporting, and mission developed and operated utilities.
MMOLMWEB (Web Services Provided by JPL at LMSS)
Provides a web server for missions supported by LMSS (Lockheed Martin Space Systems), using MGSS hardware located at their facility in Denver, CO. Typical support starts in phase C and continues through mission closeout.

1.4.2.1 AMMOS GDS Site Rep

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1.4.2.2 MGSS Web Services (MWS)

Provides a web hosting service for internal (not publically available) websites to support activities with the local and remote science team members, mission operations reporting, and mission developed and operated utilities. The MWS system is fully redundant with load balancing and system failover to ensure that customer zones (virtual machines) are available at all times and system recovery is transparent to the user. Each user is provided with a development zone, redundant test-bed zones, and redundant operational zones. Each zone includes memory, storage CPU assignment. Service includes 24x7 phone, online, and automated customer support. Onsite support is available during normal business hours (Pacific Time Zone).

1.4.2.3 MMOLMWEB (Web Services Provided by JPL at LMSS)

Provides a web server for missions supported by LMSS (Lockheed Martin Space Systems), using MGSS hardware located at their facility in Denver, CO. Typical support starts in phase C and continues through mission closeout. Mission customers use this resource for logging information, reporting, and making available mission specific databases, such as command and telemetry dictionaries. Each customer is allocated zones (virtual machines) that match their specific needs. MMOLMWEB system and service documentation is provided via a wiki.

1.4.3 Mission Support Facilities

Provides logistical consulting, architecture, engineering and support between communicating entities.

Mission Support Facilities Services

Common Access Manager (CAM)
The Common Access Manager (CAM) provides application layer access control capabilities.
MGSS CCC Platform Infrastructure Service
MGSS CCC facilitates the procurement of Platform Infrastructure (including physical server, VM licenses, and local storage) from the OCIO that has been optimized to operate the AMMOS and has been qualified on the AMMOS System Testbed.
Multimission MSA
Use of the shared [[LINK||PAGE:toolsandservices:catalogindex||Multimission MSA||]] is coordinated and planned by MGSS Operations Engineering so needs across missions are planned for and resolved.
Network Connectivity
Provides network connectivity to the mission network for project workstations, servers, and printers. The mission network is high-availability and secure. Network connection options are 10/100/1000 Mbps with fault detection and correction. Network time service, domain name service, and perimeter access control are included.
Operational Voice Service (VOCA)
Provides real-time, multi-channel, shout-down voice communications between project elements. Includes voice instruments and custom voice net set up. Service is high-availability and includes fault detection and correction.
Remote Partner Site Network Connectivity
Provides network connectivity to the mission network for remote project locations. Includes wide area network connections, as required, and the above Network Connectivity capabilities and services. Secure wide area network connections are also available.

1.4.3.1 Common Access Manager (CAM)

The Common Access Manager (CAM) provides application layer access control capabilities.
MGSS manages and operates the CAM Server that is used by the DSN (Deep Space Network) Command Preparation & Delivery (CPD) subsystem. CPD users will be authenticated by using a CAM login page before they are able to use CPD. CPD will use the CAM to verify that users have been authenticated and that they are authorized to use CPD services.

MGSS manages the authorization policies that are enforced by the CAM used by the DSN. The DSN will coordinate CPD authorization policies with a project, and provide authorization policy statements to MGSS for implementation in the CAM. MGSS will support the DSN in the design of authorization policies to ensure that policies are properly defined.
The CAM Server shall be highly available. All planned outages will be coordinated with customers to prevent adverse impacts to missions.
MGSS shall maintain the CAM software for no less than 6 years.

1.4.3.2 MGSS CCC Platform Infrastructure Service

MGSS CCC facilitates the procurement of Platform Infrastructure (including physical server, VM licenses, and local storage) from the OCIO that has been optimized to operate the AMMOS and has been qualified on the AMMOS System Testbed.

Terms and Conditions

The customer will provide support for full installation of system and any needed maintenance or repair. For all maintenance and support issues, the customer will engage the vendor as per the conditions defined in the support subscription. The term of this purchase is three years, during which the CCC/OCIO will maintain the tracking of the asset in the Asset and IT security database. At any time during the term of service, the customer may choose to return the system back to the CCC/OCIO. The CCC/OCIO reserves the right to re-allocate the system to another customer, but may not charge for the package again. At any time during the term of service, the customer may request the transfer of the system to another project. Transfers are subject to the bilateral approval of the customer and the CCC/OCIO. At the end of the three-year term, the project may elect to keep the hardware but will be required to pay for additional maintenance and licensing subscriptions from the CCC/OCIO without any additional procurement expenses or overhead.

1.4.3.3 Multimission MSA

No charge to use the Multimission MSA facility ($0). This may benefit missions that have a desire to have a footprint at JPL.

MGSS has two MSA facilities: 264-231 can accommodate up to 12 operational, and 264-225 can accommodate up to 7 (TBC) operational positions. This facility includes secure badge reader access (MEI building requirements), raised floors allowing for computer cables, video projection (2 in 264-231, 1 in 264-225), UTC clock, and a white board. The 264-231 room also has teleconference equipment, a small conference table and storage cabinets. These MSA's have access to ports for voca, network, and are supported by conditioned, UPS (battery) power and by JPL SpaceFlight Ops Facilities diesel generators in the event of power outages.. The 264-231 MSA also allows access for JPL TV Audio Visual access, including camera mounts.

The cost of populating the Multimission MSA with hardware is a Mission responsibility. The Multimission MSA does not include workstations, virtual machines, ports, phones, vocas, printer, copier, scanner, data storage, hardware labor or system administration support. Certain MGSS infrastructure can be shared between missions for less than the purchase or lease of mission-only hardware. Please contact Mission Interface Office (MIO) for more details. In addition, facility usage is coordinated and planned by MGSS.

1.4.3.4 Network Connectivity

Provides network connectivity to the mission network for project workstations, servers, and printers. The mission network is high-availability and secure. Network connection options are 10/100/1000 Mbps with fault detection and correction. Network time service, domain name service, and perimeter access control are included.

1.4.3.5 Operational Voice Service (VOCA)

Provides real-time, multi-channel, shout-down voice communications between project elements. Includes voice instruments and custom voice net set up. Service is high-availability and includes fault detection and correction.

1.4.3.6 Remote Partner Site Network Connectivity

Provides network connectivity to the mission network for remote project locations. Includes wide area network connections, as required, and the above Network Connectivity capabilities and services. Secure wide area network connections are also available.

1.4.4 Operations Mission Assurance

Increases the likelihood of mission success by proactively contributing to the identification, assessment and mitigation of risks from formulation through implementation phases of a project's life cycle.

1.4.5 Operations System Engineering

MGSS Operations System engineering is the system engineering for the MGSS operations areas, and responsible for implementing the multimission operational team support for missions. This includes coordination of operational area operational concepts, functional area requirements, ground system and infra structure requirements, interface agreements, process, procedure, training and team certification. This function is responsible for internal MGSS reviews of operational team readiness, participation in MGSS future system development, and assist operational teams with anomaly investigations.

Operations System Engineering Services

AMMOS Operations Revitalization
Updates and expands AMMOS capabilities for multimission operations. Focuses on providing adaptable, multi-mission process that decrease effort required during MOS development and decrease staffing needs for missions during flight operations.

Duty Roster
Duty Roster is a web based notification system that allows a customer (mission/service provider) to tailor operational roles to their organization structure, and enable teams and individual members to be responsible for their status.

Security Service
Provide IT security on the mission net including perimeter access control, network based and host based security controls, security monitoring, auditing, and incidence response.

1.4.5.1 AMMOS Operations Revitalization

Updates and expands AMMOS capabilities for multimission operations. Focuses on providing adaptable, multi-mission process that decrease effort required during MOS development and decrease staffing needs for missions during flight operations.

1.4.5.2 Duty Roster

The Duty Roster is a web based notification system that allows a customer (mission/service provider) to tailor functional roles that map to their organization structure, and enable teams and individual members to be responsible for their status. By mapping to an organization structure, distinct groups can be defined. Groups can be a collection of roles, resources or other groups. The entire duty roster is laid out so that a user can quickly view role and contact information they need. Additionally, it provides search capability to expedite finding individuals assigned to specific roles. Notifications can be sent to a customizable list of active roles and individuals. The system incorporates a calendar capability that provides a history of status changes and allows for scheduling future role availability. The Roster is available across a broad range of mobile devices.

Loading the player ..

1.4.5.3 Security Service

Provide IT security on the mission net including perimeter access control, network based and host based security controls, security monitoring, auditing, and incidence response.

1.5 Planning & Sequencing

Planning & Sequencing functions are responsible for the generation of mission plans, science observation plans, sequence and command generation for NASA flight projects. The

products of these uplink functions are used to communicate with and control the spacecraft. Spacecraft operability constraints, mission rules, and flight rules are enforced, and spacecraft activities, science activities, and instrument activities are merged during the planning and sequencing process to produce integrated, conflict-free command products to control the spacecraft.

Planning & Sequencing functions include activity planning tools for deep space orbiter class missions (e.g., MRO, ODY), and landed surface class missions (e.g., PHX, MSL). Product generation can be supported on strategic (e.g., weekly / monthly) and tactical (e.g., daily) timelines. The Planning & Sequencing functions enable distributed mission operations (e.g., remote spacecraft teams, remote science teams).

Mission Planning
Provides integration of plans for mission activities (science and engineering). Includes scheduling of DSN passes and ability to identify and resolve resource conflicts and produce conflict-free, integrated plans.

Observation Planning
Provides the planning of science observations and their integration into science plans, particularly as related to fitting a plan within constraints (such as pointing, data storage volume, power, etc.).

Sequence and Command Generation
Provides the integration and generation of verified and validated sequences for all mission activities. Includes automated checking of Flight Rules and constraints.

Sequence and Command Transmission
Provides for management of command files, and queuing and transmission via DSN.

1.5.1 Mission Planning

Mission Planning provides integration of plans for mission activities. Plans include scheduling of earth-spacecraft communication sessions, spacecraft activities, and science activities. Planning identifies and resolves resource (e.g., on-board data storage, power utilization) conflicts, identifies and resolves temporal conflicts amongst activities, and produces conflict-free planning products.

The Mars Relay Planning Service enables an asset orbiting Mars to return data to Earth on behalf of a landed asset and enables data from Earth to be forwarded to a landed asset via an orbiting asset. Missions that use this service integrate the earth-orbiter-lander communication sessions into their mission plans.

Multimission tools that enable Mission Planning are the Mission Planning and Sequencing (MPS) Editor, and Activity Plan Generator (APGen). The MPS Editor tool enables project users to create activity and sub-activity designs with a drag-n-drop graphical user interface. The APGen tool enables mission and science planners to perform resource-driven planning that spans the range of high-level mission scenarios to detailed science activity plans. The tool may be adapted to create the project-specific resource models and constraint definitions to enable Mission Planning.

Mission Planning Services

Deep Space Network Scheduling
The Deep Space Network (DSN) Scheduling service coordinates and negotiates DSN resources to support project activities. It includes the generation of files to support sequence and DSN Keyword File (DKF) generation processes. Mission Phase: D, E A Deep Space Network (DSN) Keyword File (DKF) is the mechanism used to configure and operate the DSN in order to radiate commands and/or receive telemetry.

Mars Relay Planning
The Mars Relay enables an asset orbiting Mars to return data to Earth on behalf of a landed asset and enables data from Earth to be forwarded to a landed asset via an orbiting asset. Mars Relay Planning involves coordinating and scheduling these relay activities.

Mission Planning Tools

MPS Editor (Mission Planning and Sequencing Editor)
Mission Planning and Sequencing Editor (MPS) enables the creation and editing of spacecraft sequences and the capability to ingest, merge, and output sequences in a variety of formats (e.g. SATF, SASF, VML, RML). Enables modeling of blocks, sequences and commands via the invocation of SEQGEN. Includes a drag-n-drop GUI to assemble blocks and sequences.

1.5.1.1 Deep Space Network Scheduling

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A Deep Space Network (DSN) Keyword File (DKF) is the mechanism used to configure and operate the DSN in order to radiate commands and/or receive telemetry.

1.5.1.2 Mars Relay Planning

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1.5.1.3 MPS Editor (Mission Planning and Sequencing Editor)

Mission Planning and Sequencing Editor (MPS) enables the creation and editing of spacecraft sequences and the capability to ingest, merge, and output sequences in a variety of formats (e.g. SATF, SASF, VML, RML). Enables modeling of blocks, sequences and commands via the invocation of SEQGEN. Includes a drag-n-drop GUI to assemble blocks and sequences.

1.5.2 Observation Planning

Observation Planning provides planning of science observations and their integration into a science plan. Observation Planning identifies and resolves resource (e.g., on-board data storage, power utilization) conflicts, identifies and resolves temporal conflicts amongst activities, and produces conflict-free planning products.

Some of the tools that enable Observation Planning are the Mission Planning and Sequencing (MPS) Editor, Activity Plan Generator (APGen), Science Opportunity Analyzer. The MPS Editor tool enables project users to create activity and sub-activity designs with a drag-n-drop graphical user interface. The APGen tool enables mission and science planners to perform resource-driven planning that spans the range of high-level mission scenarios to detailed science activity plans.

The multimission activity planning tool suite includes tools for deep space, orbiter-class missions (e.g., MRO, ODY), and lander surface class missions (e.g., PHX, MSL). The planning tools for lander surface class missions includes drag-n-drop interface to manipulate activities, resource modeling, and capabilities to ingest processed telemetry products to support the activity planning process. Processed telemetry products are used to identify possible new targets for the lander to explore, supports identification of the next location for the lander to approach, provides visuals regarding possible hazardous terrain and near by objects.

Observation Planning Tools

APGEN (Activity Plan Generator)
Enables mission and science planners to perform resource-driven planning that spans the range of high-level mission scenarios to detailed science activity plans. Constraints can be modeled and a graphical timeline enables violations to be easily identified. Can be used to create sequences, and those sequences can be validated using other MPS tools (i.e. SEQGEN).

1.5.2.1 APGEN (Activity Plan Generator)

Enables mission and science planners to perform resource-driven planning that spans the range of high-level mission scenarios to detailed science activity plans. Constraints can be modeled and a graphical timeline enables violations to be easily identified. Can be used to create sequences, and those sequences can be validated using other MPS tools (i.e. SEQGEN).

1.5.3 Sequence and Command Generation

Sequence and Command Generation merges science and engineering activities into integrated, constraint-checked, and verified and validated sequences. Modeling of the spacecraft

operability constraints, instrument operability constraints, mission rules, and flight rules are performed. Spacecraft resource consumables (e.g., power, data storage) and non-consumable states (e.g., destow, stow) are modeled.

Some of the multimission tool suites that enable Sequence and Command Generation are SEQGEN and VML (Virtual Machine Language). SEQGEN is a modeling engine for sequences and commands. The tool is a multi-threaded discrete event simulator, and can model multiple parallel sequences simultaneously, and supports event-driven sequencing. VML toolkit consists of several components that provide a standard implementation of a sequence engine. VML is a computer language (e.g., subroutine logic, arithmetic) used to generate commands. VML sequences are translated by a compiler into binary format and are interpreted by the VML flight software, which resides onboard the spacecraft.

Sequence and Command Generation Services

ASP
Provide the Automated Sequence Processor (ASP) capability to perform automatic generation of sequences and command products. Includes adaptation, implementation, and maintenance of the software, as well as training of the operations team in the use of the ASP system.
DSN Keyword File (DKF) Generation
A Deep Space Network (DSN) Keyword File (DKF) is the mechanism used to configure and operate the DSN in order to radiate commands and/or receive telemetry. The DKF Generation service produces a mission-specific DKF based upon negotiated allocations of DSN resources and spacecraft events. Mission Phase: D, E
Mission Planning & Sequence Team
Provide trained personnel to perform planning and sequencing services for the flight operations of a variety of mission types. Service extends from mission and activity planning through sequence and real-time command generation and verification. Includes development of team functional requirements, operational interfaces, training, and validation of the operational team.
Sequencing Software, Model Development, and Operations Engineering
This Uplink function is a service that consists of sequence operations engineering, and multimission software adapted to project-specific models. The combination enables quick and reliable integration of sequence requests, validation of sequences against mission-specific constraints, and generation of required command products. As a starting foundation, the sequence operations engineering employs the multimission operations process designs and procedures that utilize the multimission tools, and implements project-specific processes and tools where necessary.

Sequence and Command Generation Tools

(VML) On-Board Sequence Engine System
The Virtual Machine Language (VML) system consists of several components that provide a standard implementation of a sequence engine. In addition to enabling activities to occur at specified absolute or relative times, the VML system provides the ability to create time-tagged instructions capable of invoking functions. The VML system simulates a generic processor, memory locations, and registers (i.e. the basics of any computing environment). In order to exercise the system, a user creates instructions as text using a sequence editor. The instructions are then translated into a binary format. The resulting binary can be used by execution tools such as the VML Flight Component (VMLFC) and Offline VM (OLVM) running on the spacecraft or in a software test lab.
AMPCS Uplink
Provides a user interface for building spacecraft commands, controlling the uplink of commands and command files, and archiving command logs primarily in the spacecraft test environment.
SEQGEN (Sequence Generation)
Expand a series of science and engineering activities into their resultant spacecraft commands, model changes in spacecraft state based on commands in order to produce event predictions, model sequences expanded onboard the spacecraft and those expanded on the ground, and indicate conflicts in the modeling of commands and violations of flight rules.
SLINC/CTS (S/C Language Interpreter, Collector & Command Translation)
Spacecraft Language Interpreter and Collector (SLINC), Command Translation Subsystem (CTS) translate sequence commands from command mnemonics to binary. (CFDP binary file can also be produced.)

1.5.3.1 ASP

Provide the Automated Sequence Processor (ASP) capability to perform automatic generation of sequences and command products. Includes adaptation, implementation, and maintenance of the software, as well as training of the operations team in the use of the ASP system.

1.5.3.2 DSN Keyword File (DKF) Generation

A Deep Space Network (DSN) Keyword File (DKF) is the mechanism used to configure and operate the DSN in order to radiate commands and/or receive telemetry. The DKF Generation service produces a mission-specific DKF based upon negotiated allocations of DSN resources and spacecraft events. Mission Phase: D, E

1.5.3.3 Mission Planning & Sequence Team

Provide trained personnel to perform planning and sequencing services for the flight operations of a variety of mission types. Service extends from mission and activity planning through sequence and real-time command generation and verification. Includes development of team functional requirements, operational interfaces, training, and validation of the operational team.

1.5.3.4 Sequencing Software, Model Development, and Operations Engineering

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1.5.3.6 AMPCS Uplink

Provides a user interface for building spacecraft commands, controlling the uplink of commands and command files, and archiving command logs primarily in the spacecraft test environment.

1.5.3.7 SEQGEN (Sequence Generation)

Expand a series of science and engineering activities into their resultant spacecraft commands, model changes in spacecraft state based on commands in order to produce event predictions, model sequences expanded onboard the spacecraft and those expanded on the ground, and indicate conflicts in the modeling of commands and violations of flight rules.

1.5.3.8 SLINC/CTS (S/C Language Interpreter, Collector & Command Translation)

Spacecraft Language Interpreter and Collector (SLINC), Command Translation Subsystem (CTS) translate sequence commands from command mnemonics to binary. (CFDP binary file

can also be produced.)

1.5.4 Sequence and Command Transmission

Provides for management of command files, and queuing and transmission via DSN.

Sequence and Command Transmission Tools

RSFOS (Re-Engineered Space Flight Operations Schedules)
Graphical timeline of sequences and DSN activities.
USG (Uplink Process Tracking and Automation)
USG provides software for tracking products in the uplink process, including mission sequences and spacecraft commands, and supporting automation of mission operations via triggers and reports.

1.5.4.1 RSFOS (Re-Engineered Space Flight Operations Schedules)

Graphical timeline of sequences and DSN activities.

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